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LETTER *from the Reverend Doctor* YOUNG, *Senior Fellow of Trinity College, Dublin, and M. R. I. A. to the Right Honourable the* EARL *of* CHARLEMONT, *Preſident of the Royal Iriſh Academy.*

MY LORD,

AS the manner of extracting coal from mines is not generally known in detail in this country, perhaps the following circumſtantial account of the noted mines of Whitehaven in Cumberland by a gentleman of that country may be thought fit to be inſerted in the Tranſactions of the Academy. Read Dec. 7, 1793.

I have the honour to be,
MY LORD,
With the greateſt reſpect,
Your Lordſhip's moſt obedient,
Humble ſervant,
MATTHEW YOUNG.

OBSERVATIONS *and* INQUIRIES *made upon and concerning the* COAL WORKS *at* WHITEHAVEN *in the County of* CUMBERLAND *in the Year* 1793. *By* JOSEPH FISHER, *M. D. Fellow of the Royal Phyſical Society in Edinburgh.*

IN the neighbourhood of Whitehaven are two coal works or collieries, called Howguill and Whinguill. The firſt lies on the ſouth weſt part of the town, and the preſent works extend from the town towards the ſouth about two miles and a half, reaching nearly to the valley called Sandwith, and in breadth about one mile and a half, viz. from a rivulet called the Powbeck on the eaſt ſide to about nine hundred yards under the ſea towards the weſt, making in area about two thouſand four hundred acres. This is the extent of the preſent workings, and is aſſerted to be the moſt extenſive colliery in Great Britain.

In this colliery are now diſcovered five workable ſeams or bands of coal, beſides ſeveral ſmaller ſeams which are not worth the working.

In the pit named King-pit, which is the deepeſt pit in this colliery or in Great Britain, the firſt ſeam or band is called the Crow Coal, which is two feet two inches thick. It lies at the depth of ſixty yards.

The ſecond ſeam or band is called the Yard-band, in thickneſs four feet ſix inches, and lies at the depth of one hundred and ſixty yards.

The third ſeam is called the Bannock-band, about eight feet thick, including two metals, which are about twelve inches thick. It lies at the depth of two hundred yards.

The fourth ſeam is called the Main or Prior-band, which is from ten to twelve feet thick, and about two hundred and forty yards deep.

The fifth ſeam is called the Six-quarters Coal, about five feet thick. It lies at the depth of three hundred and twenty yards. No part of this laſt ſeam has been yet wrought.

What other ſeams lie below theſe is yet unknown. No trial has been made above twenty yards below the fifth ſeam, which makes the greateſt perpendicular depth hitherto ſunk to be three hundred and forty yards below the earth's ſurface.

It would not be difficult to perceive, before any coals were got, that this tract of land contained ſeams or bands of coal, becauſe the Bannock or third ſeam, and the Main-band or fourth ſeam, before mentioned, have burſt out, as it is termed at Whitehaven; that is, they ſhew themſelves in ſeveral places on the ſloping ſurface of the earth, on the weſt ſide of the valley leading from Whitehaven to St. Bees. To the ſouthward of this colliery theſe ſeams of coal are alſo thrown much nearer the ſurface by what is called upcaſt dykes (words which will be hereafter explained) the largeſt of which is about forty yards.

At a pit called Wilſon's pit, which is the moſt ſouthern pit in this colliery, the main band or fourth ſeam before-mentioned lies only about one hundred and forty yards below the ſurface; whereas at King-pit, as before ſtated, it lies one hundred yards deeper, or about two hundred and forty yards.

It appears that at the firſt beginning to work this colliery a level or watercourſe has been driven from the rivulet called Powbeck, near the copperas work, to the ſouth of the town about three hundred yards.

The courſe of this level is to the full dip or deſcent of the colliery, which is nearly due weſt, until it cuts or interſects the

the Bannock-band or third ſeam of coal before-mentioned. This level effectually drained about three hundred yards in length, and about one hundred yards in breadth, water level courſe, in this ſeam. The extent of coals thus drained is called a winning. The depth of the pits in this winning or extent is from twenty to ſixty yards.

The ſecond winning or extent drained has been effected by driving a level from the ſurface of the Powbeck near a farm-houſe called Thicket, further ſouthward than the firſt winning. By continuing this level to the weſtward they have cut or interſected the main band or fourth ſeam before-mentioned about four hundred yards to the dip or weſt of the outburſt or appearance of this coal at the ſurface.

This level drained about a thouſand yards in length water level courſe, and four hundred yards in breadth or dip and riſe courſe, and alſo ſomething more in breadth in the Bannoch-band ſeam of coal.

The coals obtained from theſe two winnings or extents muſt have been very conſiderable.

At that time the coals were drawn out of the pits by men with jackrolls or windlaſſes, and laid up in banks, from whence they were carried to the ſhips upon the backs of little horſes in pack loads, each pack-load containing what is called a Cumberland buſhel, conſiſting of twenty-four gallons, and each weighing about fourteen ſtones.

Having obtained as much coal as they could by theſe two levels, the third winning was made at a place now called Ginns, which is a village or hamlet near Whitehaven on the ſouth weſt.

Horizontal *vertical* wheels were erected here, called Ginns, by which they drew the coals with horſes out of the pits, which before was done by men with windlaſſes or jack-rolls.

A few houſes being built here, in conſequence, for the colliers and workmen, became a conſiderable village, now known by the name of Ginns.

With theſe ginns or vertical wheels both water and coals were drawn from the pits; but drawing the water thus by horſes and theſe vertical wheels became too expenſive, ſo that the coals drawn would not pay for the expenſes incurred. To remedy this, the late Sir James Lowther purchaſed the materials of an engine in London, which had been formerly uſed there for raiſing water to ſupply the city. Report ſays that this was the ſecond ſteam-engine which was erected in England. The materials were ſent in a ſhip from London to Whitehaven, where they were put together and fixed upon a pit near Ginns. The depth of this pit is about fifty-ſix yards from the earth's ſurface to the main band or fourth ſeam of coals. This engine had a copper boiler about ten feet in diameter, with a lead top, a braſs cylinder twenty-eight inches in diameter, and wooden pumps eight inches in diameter, with a braſs working barrel.

As the number of pits was increaſed the water augmented, until at length it was judged neceſſary to erect another engine with greater powers than the firſt. By theſe two engines the water was drained from a conſiderable extent of the Yard-band, Bannock-band and Main-band, ſeams of coals, which, being thus laid water free, ſupplied the town and export market for many years.

The pit, called Parker's-pit, about half a mile from what is called the Staith, (a place to hold a large quantity of coals) which is near the harbour, was won in the Yard-band ſeam by theſe engines.

It was from this pit that the firſt waggon-way (as it is called) was laid in this county. A waggon-way is a road for a waggon with four wheels to run upon. It is made with wood laid down faſt on each ſide of the road at a proper diſtance for the ſolid iron wheels of the waggon to move upon; the wheels are confined from running off from the wood by a protuberant rim of iron on the interior ſide of each wheel. The road is made ſo as to have a gentle deſcent along its whole length, ſo that the loaden waggon runs from the pit to the ſtaith without any horſe to draw it; where the deſcent is ſo much that the motion would be too quick, a man, who is mounted behind the waggon, by preſſing down upon one wheel a piece of wood, called the convoy, which is fixed to the waggon for that purpoſe, can reſtrain the too rapid motion and regulate it properly.

A HORSE is uſed to draw the empty waggon back again to the pit from the ſtaith by an eaſy aſcent along another ſimilar waggon-way, laid along the ſide of the former at about three feet diſtance: thus it is ſo contrived that the loaden and empty waggons never meet or interfere with each other.

THE ſtaith is a large wooden building on the weſt ſide of the town adjoining to the habour and covered in. In this ſtaith are fixed five hurries or ſpouts, at ſuch a diſtance from each other that a ſhip of three hundred tons burthen can lie under each hurry and receive a loading at one time. The ſtaith is about thirty-ſeven feet above the level of the quay, and when the waggons arrive there the bottom of each waggon is drawn out and the coals are dropped from thence into the hurry or ſpout under it, through which they run down into the ſhip laid below to receive her loading. The hurries or ſpouts lie with an inclining ſlope of about forty-five degrees.

WHEN there are no ſhips ready to receive coals they are depoſited in the ſtaith, which will contain about ſix thouſand tons, Dublin meaſure, or three thouſand waggon loads. Theſe coals thus depoſited are once more put into waggons and dropped through the hurries or ſpouts into ſhips, when there are more veſſels than the uſual daily ſupply of coals will load. There have been two hundred waggon loads, or four hundred Dublin tons, ſhipped from the pits in one day, and an equal quantity on the ſame day from the ſtaith, making in the whole about eight hundred tons, Dublin meaſure.

By the contrivance of waggons and waggon-roads, one horſe carries as much coals at once as twenty-four horſes uſed to do upon their backs before this invention.

The fourth winning or extent of coal drained was made about eighty years ago, at a place called Saltom near the ſea, about a mile ſouth weſt of Whitehaven. This was a very expenſive undertaking; it was, however, deemed abſolutely neceſſaay, as on the completion of this depended the future ſucceſs of this colliery. A fire engine was therefore erected here with a twelve feet boiler, a cylinder forty inches in diameter, and a pump ſeven inches in diameter. The pumps were divided into four ſets or lifts, the pit being one hundred and fifty-two yards in perpendicular depth. It was perceived neceſſary, however, a few years afterwards, to erect a ſecond ſteam-engine in this place of the ſame dimenſions as the firſt, becauſe the water was increaſed very conſiderably by ſinking ſeveral new pits.

The fields of coal already drained by theſe two engines have been explored from north to ſouth about three miles, and may probably be extended about three miles more when wanted. The coal now drained, and ready to be wrought in the ſeveral working pits at preſent, will ſerve for about twenty years, according to the quantity now drawn. Pits, however, being in ſome time naturally exhauſted, it is thought prudent now and then to drive what is called trial drifts, in order to explore the fields of coal, and to find proper places where to make new pits, when the ſame may be wanted.

About twelve years ago, theſe two engines being nearly worn out, a new one was erected at Saltom, capable of drawing more water than the two old ones. It has two boilers, each fifteen feet in diameter, a cylinder ſeventy inches in diameter, and a working barrel eleven inches and a half. It can draw all the water in eight hours which is produced in ſummer in twenty-four hours, but in winter it requires double that time as there is double the quantity of water. This engine was repaired about three years ago at a very great expenſe, with a new cylinder, new regulating beam, and new cylinder and ſpring beams. At this time it is admitted, by ſeveral profeſſional men who have examined it, to be the beſt engine of the ſize within the kingdom. Its maximum in working is fifteen ſtrokes, each ſix feet and a half long in a minute; each ſtroke draws twenty-ſeven gallons of water, that is, four hundred and five gallons per minute, or nine thouſand two hundred and forty hogſheads every hour.

All the bands or ſeams of coal in this colliery dip or deſcend nearly due weſt, ſloping towards the horizon with a deſcent of one yard in eight to one in twelve, and the ſeams are always and invariably equally diſtant from each other, whatever be the depth. However, though theſe ſeams of coal are thus always equally diſtant from each other, yet they are not equally deep from the earth's ſurface. The ſeams, as before-mentioned, conſtantly dip or deſcend towards the weſt, and riſe towards the eaſt, till at length they ſhew themſelves in ſome places on or near the earth's ſurface.

Besides this general deſcent or aſcent, the ſeams are in ſome places abruptly broken off by a bed of ſtone or other matter of a conſiderable thickneſs, betwixt the coal and which there is generally a cavity or hollow called at Whitehaven a Gut. When a ſeam of coal is thus interrupted by the interpoſition of other matter the workmen know that they will find the ſame ſeam either above or below this place, or, as they term it, they know that the ſeam is thrown either upward or downward. In order to know whether the ſeam of coal will be found above or below, they endeavour to diſcover which way the ſtone or other ſeparating matter hangs or ſlopes. If it recedes from the coal, ſloping ever ſo little upwards, they conclude that the ſeam of coal is thrown upwards (as they call it), that is, in ſuch a caſe the ſeam is always found above the break. If the ſlope be hanging over the coals, ſloping towards the ſurface, then the ſeam of coal is ſaid to be thrown downwards, and is found below the break. The real fact is, that in ſome former time there has been ſome great convulſion of the earth, in which all the ſuperincumbent covering matter, conſiſting of ſeams or beds of ſtone, coals or other materials, have been moved upwards in all ſuch chaſms or breaks, leaving the ſeam or bed of coal below, in one part, where it was at the time the dreadful convulſive motion happened. Hanging over and ſloping upwards or downwards are only relative terms, depending upon which ſide of the interpoſed matter you arrive at. Where any ſeam or field coal ſeems thus to end, the interpoſing matter hangs or ſlopes one way on one ſide of the matter and the contrary on the other

ſide,

ſide, ſo that the ſuperincumbent matter with the ſeam of coals has been invariably thrown upwards by the convulſion, whilſt the remaining part of the bed has been left as it was before the motion.

WHITEHAVEN collieries abound with what they there call Dykes, that is, beds of ſtone of a conſiderable thickneſs, which ſeparates one field of coal from another. The principal ones run in a direction nearly eaſt and weſt. They divide the ſeams of coal into fields, as they are called, that is, ſeparate tracts of coal almoſt like the fields or incloſures of a farm. Theſe dykes or ſeparations are very uſeful, by reſtraining the water or inflammable air from flowing out of any adjoining field of coal, where no works are going on, into another where men are working, until it is found convenient to cut through or work a new field. Without theſe dykes it would frequently be very difficult to keep the works from being overcharged with water, but it is ſometimes very troubleſome and expenſive to cut through them, being of a conſiderable thickneſs. Where the covering of ſuperincumbent matter is not of ſo great a thickneſs, which is towards the riſe of the ſeam or field, there pillars of coal are left from five to ten yards ſquare, and the workings are from three to four yards wide, ſo that about one-half of the coal is taken away, and the other half left to ſupport the earth above. Where the coals lie from one hundred and fifty to three hundred yards deep, and eſpecially where the coal is drawn from under the ſea, the pillars are left from ſixteen to twenty yards ſquare, ſo that about

about one-third part of the coal is taken, and two-third parts are left to ſupport the roof.

WHITEHAVEN colliery is not ſo much loaden with water as the collieries about Newcaſtle and other flat countries are, where they are not able, by what is called day levels, to take away the top water, called ſurface feeds, as is practiſed at Whitehaven.

THE coal works at Whitehaven have produced and ſtill do produce greater quantities of inflammable air, commonly called damp, than any other coal work known. This ſeems to ariſe from the coal lying at a greater depth below the level of the ſea than any other known colliery. This obſervation holds invariably true both here and about Newcaſtle, that in all coal works lying above the level of the ſea little or no inflammable air is perceived, except in the guts of the dykes, that is, in the cavities or hollows betwixt the fields of coal and the dykes or beds of ſtone which ſeparate the fields. The quantity of inflammable air appears to bear proportion to the depth of the works below the level of the ſea.

WHEN they began to ſink the coal pits at Whitehaven ſo deep that coals were drawn from below the level of the ſea, inflammable air was found in ſuch quantities that it frequently took fire from the flame of the candles uſed by the workmen under ground, which cauſed violent and dangerous exploſions, by which numbers of the workmen were burned and maimed, and

by

by which ſeveral loſt their lives. Mr. Spedding, a late eminent engineer and director of the coal works at Whitehaven, diſcovered that ſparks produced from flint and ſteel were not nearly ſo productive of theſe exploſions, by kindling the inflammable air, as the flame of candles was. He therefore contrived a machine, compoſed ſo that by being turned about by a wheel it ſtruck a great number of flints againſt ſteel in perpetual ſucceſſion. This gives light ſufficient for the workmen to work by in ſuch depths as the inflammable air abounds in, whereby the danger is greatly abated. Without this or ſome ſimilar contrivance the deepeſt coal works would probably before this have been totally given up, as being ſo dangerous to the men employed.

It is now about one hundred and fifty years ſince coals are ſuppoſed to have been firſt raiſed here for exportation. What the quantity exported has been at different periods cannot now be well aſcertained. Within the laſt twenty years the export trade has increaſed about one-third part of what it now is. Whitehaven colliery has produced for a few years laſt paſt from one hundred thouſand to one hundred and twenty thouſand tons, Dublin meaſure, yearly. Two tons contain about a chaldron and a quarter, London meaſure. In general a Whitehaven waggon of coals contains two Dublin tons, each ton weighing from twenty-one to twenty-two hundred weight. The beſt coals are invariably the lighteſt. One-third part of the main band ſeam, which lies in the middle thereof, would, if ſeparated, be as good as the beſt Newcaſtle coal. The bank or bottom is worſe in quality, but when mixed they are allowed to be the beſt coals raiſed in the county of Cumberland.

On the ſouth-weſt ſide of Whitehaven, in the part called Preſton Iſle, there appears to be coal enough to ſupply exportation at the preſent rate for near two hundred years to come. There are three day holes, called Bear-mouths, where the men and horſes go from the ſurface down a ſloping cavern to the works; they are made into the different ſeams of coal. By theſe entrances horſes are daily brought down, to draw the coals from the places where they are hewn, in waggons, along a waggon way under the ground, made as beforementioned, to the bottom of the reſpective pits, where they are put into baſkets, and drawn perpendicularly up to the earth's ſurface by ſteam engines, through a ſpace of near three hundred yards in depth in ſome places. Each engine performs what twenty-four horſes uſed to do formerly. The men alſo walk up and down theſe caverns to and from their work, which is much eaſier and leſs troubleſome than being let down and drawn up through the pits each night and morning, which was formerly done. In ſhort every thing is moſt wonderfully contrived to ſave labour and expenſe.